

Budgets and Schedules

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FY07 Budget Planning Meeting
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WE ARE PROCEEDING WITH AN ALTERNATE OPERATING SCHEDULE

- Collects three vent periods (4 months each) into one 12 month torus opening
- Enables effective use of existing staff to take on some major projects
- Preserves run time capability
 - FY05 (14 weeks)
 - FY06 (5 run weeks, incremental request 12 weeks)
 - FY07 (12 run weeks, incremental request 25 weeks, new capabilities)

DIII-D Facility Schedules (04-07)

Activity Name	Fiscal Year 2004							Fiscal Year 2005							Fiscal Year 2006							Fiscal Year 2007																											
	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A											
Previous Operating Schedule FY04-07	Operations							Cool down / Close / Vent Startup							Operations							Cool down / Close / Vent Startup							Operations							Cool down / Close / Vent Startup							Operations						
	18 weeks							Install Repair							14 weeks							Install Repair							14 weeks							Install Repair							14 weeks						
Present Schedule FY04-07	Operations							Operations							Cool down / Vent							Long Torus Opening							Close / Startup							Operations /													
	18 weeks							14 weeks																					5 weeks							Contingency							12 weeks						
	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A											

- Enables:
 - ECH- 6 long pulse gyrotrons
 - Rotation of 210 degree beamline to counter and MSE diagnostic
 - Lower divertor modification
 - Cooling water tower replacement
 - MG refurbishment
 - TF belt bus cooling and freewheeling diodes for 10 s ops

OPERATING SCHEDULES FY06-07

PROPOSED DIII-D FY2006 OPERATIONS SCHEDULE																																
Oct 05							Nov 05							Dec 05							Jan 06											
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S					
						1							1	2	3	4	5					1	2	3		1	2	3	4	5	6	7
2	3	4	5	6	7	8	6	7	8	9	10	11	12	4	5	6	7	8	9	10	8	9	10	11	12	13	14					
9	10	11	12	13	14	15	13	14	15	16	17	18	19	11	12	13	14	15	16	17	15	16	17	18	19	20	21					
16	17	18	19	20	21	22	20	21	22	23	24	25	26	18	19	20	21	22	23	24	22	23	24	25	26	27	28					
23	24	25	26	27	28	29	27	28	29	30				25	26	27	28	29	30	31	29	30	31									
30	31																															
Feb 06							Mar 06							Apr 06							May 06											
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S					
						1	2	3	4				1	2	3	4					1		1	2	3	4	5	6				
5	6	7	8	9	10	11	5	6	7	8	9	10	11	2	3	4	5	6	7	8	7	8	9	10	11	12	13					
12	H	14	15	16	17	18	12	13	14	15	16	17	18	9	10	11	12	13	14	15	14	15	16	17	18	19	20					
19	20	21	22	23	24	25	19	20	21	22	23	24	25	16	17	18	19	20	21	22	21	22	23	24	25	26	27					
26	27	28					26	27	28	29	30	31		23	24	25	26	27	28	29	28	H	30	31								
														30																		
Jun 06							Jul 06							Aug 06							Sep 06											
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S					
						1	2	3					1							1	2	3	4	5			1	2				
4	5	6	7	8	9	10	2	3	4	5	6	7	8	6	7	8	9	10	11	12	3	4	5	6	7	8	9					
11	12	13	14	15	16	17	9	10	11	12	13	14	15	13	14	15	16	17	18	19	10	11	12	13	14	15	16					
18	19	20	21	22	23	24	16	17	18	19	20	21	22	20	21	22	23	24	25	26	17	18	19	20	21	22	23					
25	26	27	28	29	30		23	24	25	26	27	28	29	27	28	29	30	31			24	25	26	27	28	29	30					
							30	31																								

Plasma physics 5 weeks
 Startup
 Option 12 weeks 7 weeks

PROPOSED DIII-D FY2007 OPERATIONS SCHEDULE																											
Oct 06							Nov 06							Dec 06							Jan 07						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
1	2	3	4	5	6	7							1	2	3	4					1	2					
8	9	10	11	12	13	14	5	6	7	8	9	10	11	3	4	5	6	7	8	9	7	8	9	10	11	12	13
15	16	17	18	19	20	21	12	13	14	15	16	17	18	10	11	12	13	14	15	16	14	15	16	17	18	19	20
22	23	24	25	26	27	28	19	20	21	22	23	24	25	17	18	19	20	21	22	23	21	22	23	24	25	26	27
29	30	31					26	27	28	29	30			24	25	26	27	28	29	30	28	29	30	31			
														31													
Feb 07							Mar 07							Apr 07							May 07						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
						1							1							1							
4	5	6	7	8	9	10	4	5	6	7	8	9	10	8	9	10	11	12	13	14	6	7	8	9	10	11	12
11	H	13	14	15	16	17	11	12	13	14	15	16	17	15	16	17	18	19	20	21	13	14	15	16	17	18	19
18	19	20	21	22	23	24	18	19	20	21	22	23	24	22	23	24	25	26	27	28	20	21	22	23	24	25	26
25	26	27	28				25	26	27	28	29	30	31	29	30						27	H	29	30	31		
Jun 07							Jul 07							Aug 07							Sep 07						
S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S
						1							1							1							1
3	4	5	6	7	8	9	8	9	10	11	12	13	14	5	6	7	8	9	10	11	2	3	4	5	6	7	8
10	11	12	13	14	15	16	15	16	17	18	19	20	21	12	13	14	15	16	17	18	9	10	11	12	13	14	15
17	18	19	20	21	22	23	22	23	24	25	26	27	28	19	20	21	22	23	24	25	16	17	18	19	20	21	22
24	25	26	27	28	29	30	29	30	31					26	27	28	29	30	31		23	24	25	26	27	28	29
																					30						

Plasma physics 12 weeks
 Startup
 Vent
 Option 20 weeks 8 weeks
 Option 25 weeks 5 weeks





A STRONG COLLABORATION BETWEEN GA (DIII-D) AND ASIPP (EAST) IS BENEFITING BOTH SIDES GREATLY

GA (DIII-D) to ASIPP (EAST)

1. Train ASIPP scientists on DIII-D plasma control system
2. DIII-D plasma control system for EAST
3. GA assists in designing the EAST divertor
4. GA leads design of cryopumps for EAST
5. GA provides two new ion sources for EAST
6. GA assists ASIPP in RWM coil design

ASIPP (EAST) to GA (DIII-D)

1. ASIPP provides three operations support persons to DIII-D
2. ASIPP provides engineers to help design the DIII-D lower divertor modification
3. ASIPP fabricates parts for the lower divertors
4. ASIPP fabricates parts to refurbish eight DIII-D ion sources
5. ASIPP provides main HV substation (138 kV–12,47 kV, 110 MVA) transformers
6. Possibly ASIPP fabricates new NBI pole shields

THE FY06 \$4.3M GUIDANCE BUDGET REDUCTION WILL REQUIRE LARGE STAFF REDUCTIONS

We propose to restore those staff reductions in the 12 week case for FY07

	FY05	FY06	FY07
DIII-D National Budget	\$55,666K	\$51,374K	\$57,101K
Run Weeks	14	5	12
FTE Total Program	184.3	165.5	181.5

DIII-D NATIONAL FUSION PROGRAM

Institutional Budget Distribution (\$000) Science and Operations FY05-07

	<u>FY05</u>	<u>FY06</u>	<u>FY06 (I)</u>	<u>FY07</u>	<u>FY07 (I)</u>
<u>DIII-D PROGRAM</u>	55.7	51.4	10.0	57.1	8.9
SCIENCE	24,562	21,758	3,991	25,351	915
FACILITY OPERATIONS	31,104	29,616	5,994	31,750	7,962
RUN WEEKS	14	5	12	12	25
<u>SCIENCE</u>	24.6	21.8	4.0	25.4	0.9
GA DIII-D FUSION SCIENCE RESEARCH	15,483	12,666	3,112	15,915	0
GA	13,318	10,965	2,858	13,849	0
COLLABORATION SUPPORT FROM GA CONTRACT	2,165	1,701	254	2,066	
UCLA	515	725	625	515	
U. MARYLAND	25			25	
U. IRVINE	101			101	
U. TORONTO	67			67	
OTHER GA COLLABORATOR SUBCONTRACTS	17			17	
GA COLLABORATOR SUPPORT	1,440	1,076	154	1,341	
<u>COLLABORATORS</u>	9,079	9,092	879	9,436	915
PPPL	3,012	3,179	190	3,198	90
LLNL	2,485	2,488	655	2,560	795
ORNL	1,660	1,662		1,686	
UCSD	815	690		840	
U. TEXAS	374	374		385	
COLUMBIA	300	266	34	320	30
SNL	156	156		161	
U. WISCONSIN	151	151		156	
GEORGIA TECH.	126	126		130	
<u>FACILITY OPERATIONS</u>	31.1	29.6	6.0	31.7	8.0
GA	28,297	27,432	4,984	29,109	7,152
COLLABORATORS	2,807	2,184	1,010	2,641	810
PPPL	1,338	1,124	310	1,105	410
LLNL	583	479	300	600	250
ORNL	886	581	400	936	150



SCIENCE: All Physics activities, Collaboration Subcontracts and Support, and construction of new Diagnostics.
 OPERATIONS: Base Tokamak, Heating Systems, Diagnostics, Data Systems Operations & Maintenance and Operations Support

032-05/RDS/jy

DIII-D NATIONAL FUSION PROGRAM

Institutional Staffing Distribution (FTE'S) Science and Operations FY05-07

	<u>FY05</u>	<u>FY06</u>	<u>FY06 (I)</u>	<u>FY07</u>	<u>FY07 (I)</u>
<u>DIII-D PROGRAM</u>	184.3	165.5	25.6	181.5	18.0
SCIENCE	85.8	74.0	11.9	82.7	3.7
FACILITY OPERATIONS	98.5	91.5	13.7	98.8	14.3
RUN WEEKS	14	5	12	12	25
 <u>SCIENCE</u>	 85.8	 74.0	 11.9	 82.7	 3.7
GA STAFF	44.4	35.0	8.4	42.9	0.0
COLLABORATORS	41.4	39.0	3.5	39.8	3.7
GA CONTRACT SUPPORTED	4.8	4.1	0.0	4.5	0.0
UCLA	3.5			3.3	
U. MARYLAND	0.1			0.1	
U. IRVINE	0.8			0.7	
U. TORONTO	0.3			0.3	
OTHER GA COLLABORATOR SUBCONTRACTS	0.1			0.1	
 DOE DIRECT SUPPORTED	 36.6	 34.9	 3.5	 35.3	 3.7
PPPL	10.0	9.5	0.6	9.8	0.3
LLNL	9.5	9.0	2.5	8.8	3.0
ORNL	4.7	4.6		4.7	
UCSD	4.9	4.9		4.7	
U. TEXAS	2.8	2.8		2.8	
COLUMBIA	2.1	1.7	0.4	2.1	0.4
SNL	1.0	1.0		1.0	
U. WISCONSIN	1.2	1.0		1.0	
GEORGIA TECH	0.4	0.4		0.4	
 <u>FACILITY OPERATIONS</u>	 98.5	 91.5	 13.7	 98.8	 14.3
GA	88.9	83.2	11.9	90.3	13.2
COLLABORATORS	9.6	8.3	1.8	8.5	1.1
PPPL	4.0	3.3	0.2	2.4	0.5
LLNL	2.0	2.0		2.5	
ORNL	3.6	3.0	1.6	3.6	0.6



SCIENCE: All Physics activities, Collaboration Subcontracts and Support, and construction of new Diagnostics.
 OPERATIONS: Base Tokamak, Heating Systems, Diagnostics, Data Systems Operations & Maintenance and Operations Support

032-05/RDS/jy

VARIOUS RUN WEEK CASES FOR FY06 AND FY07

	FY06	FY06(I)	FY07 Cases					all values \$K
Run Weeks	5	12	0	6	12	16	20	25
Shifts Per Day	1	1	1	1	1	1	1	1.5
GA								
GA FTE	118.18	133	120	127	133.2	133.2	133.2	136.2
GA Operations FTE	83.16	90	83	87	90.3	90.3	90.3	93.3
GA Science FTE	35.02	43	37	40	42.9	42.9	42.9	42.9
GA Operations Labor \$	\$21,080	\$22,814	\$21,745	\$22,793	\$23,658	\$23,658	\$23,658	\$24,444
GA Science Labor \$	\$10,823	\$13,289	\$11,699	\$12,648	\$13,565	\$13,565	\$13,565	\$13,565
Total GA Labor \$	\$31,903	\$36,103	\$33,445	\$35,441	\$37,223	\$37,223	\$37,223	\$38,009
GA Operations Procurements	\$6,352	\$7,152	\$3,781	\$4,731	\$5,451	\$5,931	\$6,411	\$7,011
GA Science Procurements	\$1,843	\$2,350	\$2,250	\$2,350	\$2,350	\$2,350	\$2,350	\$2,350
GA Procurements	\$8,195	\$9,502	\$6,031	\$7,081	\$7,801	\$8,281	\$8,761	\$9,361
GA Operations Budget	\$27,432	\$29,966	\$25,526	\$27,524	\$29,109	\$29,589	\$30,069	\$31,455
GA Science Budget	\$12,666	\$15,639	\$13,949	\$14,998	\$15,915	\$15,915	\$15,915	\$15,915
GA Total Budget	\$40,098	\$45,605	\$39,476	\$42,522	\$45,024	\$45,504	\$45,984	\$47,370
Collaborator Operations	\$2,184	\$2,807	\$2,376	\$2,508	\$2,641	\$2,641	\$2,641	\$2,641
Collaborator Science	\$9,092	\$9,079	\$8,492	\$8,964	\$9,436	\$9,436	\$9,436	\$9,436
Total Collaborators Budget	\$11,276	\$11,886	\$10,868	\$11,472	\$12,077	\$12,077	\$12,077	\$12,077
Total Operations Budget	\$29,616	\$32,773	\$27,902	\$30,032	\$31,750	\$32,230	\$32,710	\$34,096
Total Science Budget	\$21,758	\$24,718	\$22,441	\$23,962	\$25,351	\$25,351	\$25,351	\$25,351
Total DIII-D Budget	\$51,374	\$57,491	\$50,344	\$53,994	\$57,101	\$57,581	\$58,061	\$59,447

FY06 RESEARCH GOALS

5 Weeks Operation

- **Milestone 161: Initial operation of DIII-D with co plus counter neutral beam injection**

12 Weeks Operation (Incremental)

- **Milestone 162: Assessment of density control in pumped, balanced double-null divertors**
- **Milestone 163: Assess the synergistic effect of plasma rotation and feedback control of resistive wall modes**



FY07 RESEARCH GOALS

12 Weeks Operation

- Milestone 162: Assessment of density control in pumped, balanced double-null divertors
- Milestone 163: Assess the synergistic effect of plasma rotation and feedback control of resistive wall modes
- Milestone 164: Evaluate quiescent H-mode experiments with co-plus counter injection

25 Weeks Operation (Incremental)

- Milestone 165: Assess stability limits compatible with steady-state operation in advanced tokamak plasmas with high triangularity double-null configuration
- Milestone 166: Evaluate modulated electron cyclotron current drive for stabilizing neoclassical tearing modes
- Milestone 167: Compare high pressure gas jet penetration for disruption mitigation and theoretical predictions



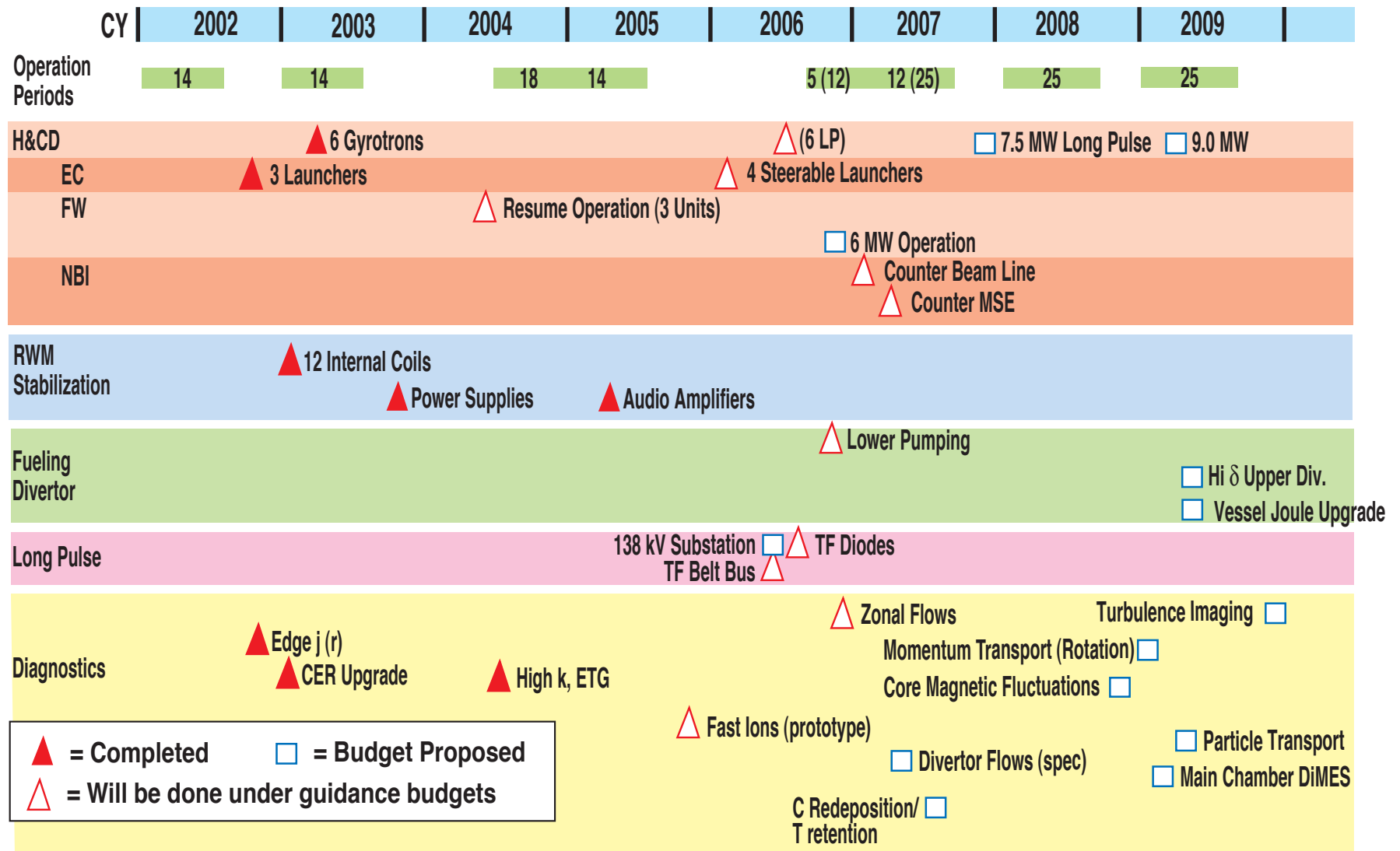
ADDITIONAL RUNTIME ON DIII-D IN FY07 WILL ALLOW IMPORTANT SCIENTIFIC ISSUES TO BE ADDRESSED

Runtime	6 Weeks	12 Weeks	16 Weeks	20 Weeks	25 Weeks
Stability science	2/1 Suppression at high β	Disruption mitigation, runaway electron suppression		NTM stabilization by modulated ECCD	
Transport science	Electron turbulence measurement and transport, $0.5 < T_i/T_e < 2$	ITB, role of Shafranov shift and $E \times B$ flow	GYRO comparison with turbulence measurements		
Boundary science	DND particle control physics		Boundary flow and impurity transport	Crossfield transport in SOL	
Heating and CD science		FWCD code validation	Far off-axis ECCD		Full bootstrap discharges
High β , high bootstrap AT	β -limit in stationary DND AT		Develop active $J(r)$ control in high β DND		Optimize steady-state with active profile control
Pedestal	Pedestal characteristics in pumped double null	Evaluate stochastic edge in pumped DND		Control of pedestal and ELMs	
RWM		RWM control at low rotation	Evaluate dissipation models		$n = 2$ RWM stability and control
QH-mode		Access with co plus counter NBI	Compare DND, SND		Physics extrapolation
High ℓ_i			Stability limit	Sawtooth stability	Demonstrate integrated scenario
Hybrid physics basis			Impact of q -profile and v_ϕ profile on transport	$T_i/T_e \rightarrow 1$	Compatibility with divertor
Fast particle physics				Core Alfvén eigenmodes mode structure validate codes	Fast ion profile and transport by core modes
VH-mode					Sustain ELM free high β_{ped}

SUMMARY OF DIII-D PROGRAM INCREMENTAL BUDGET REQUESTS

	FY06	FY07
Retain Scientific Staff	\$3,198K GA \$2,979K COLLABORATORS \$219K	\$357K COLLABORATORS \$357K
Retain Operating Staff	\$1,814K GA \$1,734K COLLABORATORS \$80K	\$789K GA \$789K
Consumables for Increased Operating Time	\$800K (To 12 Weeks) GA \$800K	\$1,710K (To 25 Weeks) GA \$1,710K
SUB-TOTAL	\$5,812K	\$2,856K
Add Students / Postdocs	\$330K LLNL (2) \$330K	\$1,330K Universities (20) \$1,000K LLNL (2) \$330K
Power Systems High Voltage Distribution Serial Highway to Ethernet Audio Amplifiers: RWM Control	\$372K GA \$296K PPPL \$76K	\$1,335K GA \$938K GA \$397K
Neutral Beam Refurbishments Power Supply Local Control Stations Replace Damaged Pole Shields	\$1,188K GA \$1,188K	\$1,685K GA \$1,010K GA \$675K
ECH ECH / Transmission lines 7 & 8 P2005 Steerable Launcher / Steering Upgrades	\$0K	\$1,251K GA \$1,009K PPPL \$242K
Diagnostic Refurb. / Upgrades Fast Ion Profile Fast ELMS Data Acquisition Upgrade IRTV Heat Flux in Double Null Reflectometer Pellet Injector Upgrade	\$559K GA/UCI \$170K LLNL \$150K LLNL \$50K PPPL \$89K ORNL \$100K	\$150K LLNL \$50K ORNL \$100K
FAST WAVE RF & Long Pulse Antenna 117MHz ABB Conversion	\$460K ORNL \$300K PPPL \$160K	\$315K ORNL \$150K PPPL \$165K
New Diagnostics MSE for Counter Neutral Beam	\$300K LLNL \$300K	\$250K LLNL \$250K
SUB-TOTAL	\$3,209K	\$6,316K
TOTALS	\$9,021K	\$9,172K

DIII-D WILL RESUME OPERATION IN MID FY06 WITH EXCITING NEW CAPABILITIES

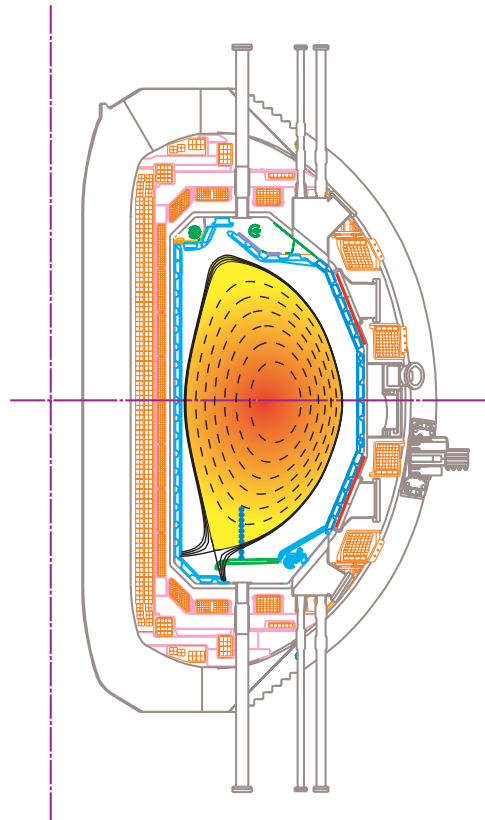


CONTINUED RESEARCH ON DIII-D UNTIL ITER OPERATES WILL SIGNIFICANTLY ADVANCE THE RESEARCH PROGRAM ON ITER

- Major DIII-D contributions to the science basis for ITER in confinement, stability, heating and current drive, pedestal, and divertor physics, and long-pulse scenario development

DIII-D

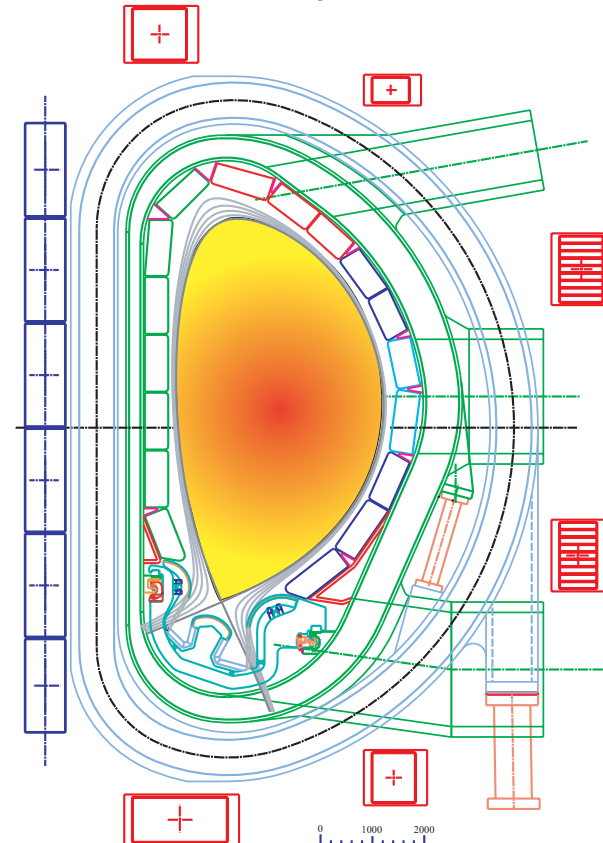
$$\delta_{x-pt} = 0.63$$



DIII-D Elevation 120°

ITER

$$\delta_{x-pt} = 0.58-0.68$$



- DIII-D is ~1/4 scale ITER

DIII-D PROGRAM ELEMENTS SUPPORT ITER

- **Develop long pulse, high performance discharges for ITER**
 - Our vision: by the time ITER operates, advanced long-pulse operational scenarios will become the new reference for ITER
- **MHD stabilization (NTM and RWM stabilization)**
- **Disruption characterization and mitigation**
- **Fast ion physics and fast particle driven instabilities in AT regimes**
- **Validate models of ECCD and FWCD**
- **Develop core transport models**
 - To validate performance projections
 - To guide ITER operation
- **H-mode pedestal understanding and control**
 - ELM mitigation; QH-mode, stochastic edge
- **Physics of impurity and tritium mass transport**
 - Erosion, redeposition, ELMs; measure flows
- **Reduction of heat flux to the divertor, radiative divertor**

— In cooperation with our ITER partners and the International Tokamak Physics Activity —

DIII-D WILL CONTINUE TO BE A WORLD CLASS PROGRAM AND FACILITY TO CARRY THE U.S. PROGRAM FORWARD TO BURNING PLASMAS

- **DIII-D program will complete key research for ITER**
 - Strong international partnerships
 - IEA/ITPA joint experiments
- **DIII-D program will develop solid scientific base for steady state high performance discharges in support of ITER and beyond**
- **DIII-D program will play a lead role in advancing plasma and fusion science**
- **Added plasma control capabilities and new physics measurements realized during the long torus opening will make DIII-D a flexible and versatile research facility with**
 - Increased scientific productivity
 - Increased scientific excellence

